INCH-POUND
MIL-S-22698C(SH)
29 June 1988
SUPERSEDING
MIL-S-22698B(SH)
10 April 1981
(See 6.4 and 6.8)

MILITARY SPECIFICATION

STEEL PLATE, SHAPES AND BARS, WELDABLE ORDINARY STRENGTH AND HIGHER STRENGTH: STRUCTURAL

This specification is approved for use within the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers ordinary strength and higher strength steel plate, shapes and bars.

1.2 Classification.

1.2.1 Grades. Plates, shapes and bars covered by this specification shall be of the following grades, as specified (see 6.2.1):

Ordinary strength structural steel

Plate
- A: ABS grade A - 1/2 inch or less in thickness
- B: ABS grade B - up through 1 inch in thickness
- D: ABS grade D
- E: ABS grade E

Shapes
- A: ABS grade A - shapes with web 3/4 inch and less in thickness
- B: ABS grade B - shapes with web up through 2 inches in thickness

Bar
- A: ABS grade A - 3/4 inch or less in thickness
- B: ABS grade B

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 9515

Higher strength structural steel

Plate
- AH-36T: ABS grade AH-36 with ultrasonic (UT) testing
- AH-36TZ: ABS grade AH-36 with through thickness properties and UT testing
- DH-36: ABS grade DH-36
- EH-36Z: ABS grade EH-36 with through thickness properties
- EH-36T: ABS grade EH-36 with UT testing
- EH-36TZ: ABS grade EH-36 with through thickness properties and UT testing

Shapes
- AH-36: ABS grade AH-36 with web 2 inches and less in thickness
- AH-36T: ABS grade AH-36 with web 2 inches and less in thickness and with fine grain practice and UT testing
- AH-36TZ: ABS grade AH-36 with web 2 inches and less in thickness with fine grain practice, UT testing, and through thickness properties

Bar
- AH-36: ABS grade AH-36
- AH-36T: ABS grade AH-36 with UT testing
- AH-36TZ: ABS grade AH-36 with through thickness properties and UT testing
- EH-36: ABS grade EH-36

1.2.2 Classes. Surface finish of plates, shapes and bars covered by this specification shall be of the following classes, as specified (see 6.2.1):

Class P - Descaled and painted
Class U - Mill finish (hot rolled or normalized)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Standard. The following standard forms a part of this specification to the extent specified herein. Unless otherwise specified, the issue of this document shall be that listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

STANDARD

MILITARY

MIL-STD-271 - Requirements for Nondestructive Testing Methods.

(Copies of standards and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN BUREAU OF SHIPPING (ABS)

ABS Rules for Building and Classing Steel Vessels.

(Application for copies should be addressed to the American Bureau of Shipping, 45 Eisenhower Drive, Paramus, NJ 07652.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 6 - Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use. (DoD adopted)

A 370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. (DoD adopted)

A 505 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled, General Requirements for. (DoD adopted)

A 700 - Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment. (DoD adopted)

A 770 - Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications. (DoD adopted)

E 208 - Standard Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3, 6.2.1, and 6.3).

3.2 General. Unless otherwise specified (see 1.2.1 and 6.2.1), steel plates, shapes, and bars shall be in accordance with section 43, ABS Rules for Building and Classing Steel Vessels. Additional requirements may be specified for particular U.S. Navy applications.

3.2.1 Extrusions. Extrusions shall consist of one piece, reduced from a billet to the final section in a one-pass hot-extrusion operation. Hot-wrought materials shall be produced by hot forming ingots, billets, or other semi-finished forms to the final product.

3.2.2 Weld repair. Weld repair of plate, shape, or bar defects shall be in accordance with section 43 of the ABS rules and with the following additional requirements. Weld repairs shall be magnetic particle inspected in accordance with MIL-STD-271 and shall be free of relevant linear indications longer than 1/8 inch. After weld repair, the area of the repair shall be inspected by the same nondestructive method as revealed the original indication.

3.3 Dimensional tolerances. Unless otherwise specified (see 6.2.1), dimensional tolerances shall be in accordance with section 43 of the ABS Rules. Where dimensional tolerances are not delineated in section 43 of the ABS Rules, they shall be in accordance with ASTM A 6 or ASTM A 505, as applicable.

3.3.1 Dimensional tolerances for EH-36T and EH-36TZ. Dimensional tolerances for EH-36T and EH-36TZ shall be in accordance with table I.

TABLE I. Thickness tolerances 1/ in inches (average) over ordered thickness for a single plate.

Specified thickness, inches 3/	Tolerances over ordered thickness for widths given 2/										
	48 in. or under	48 to 60 in. excl.	60 to 72 in. excl.	72 to 84 in. excl.	84 to 96 in. excl.	96 to 108 in. excl.	108 to 120 in. excl.	120 to 132 in. excl.	132 to 144 in. excl.	144 to 168 in. excl.	168 in. and over
1/4	0.015	0.015	0.021	0.021	0.027	0.027	0.035	-----	-----	-----	-----
5/16	.015	.015	.021	.027	.027	.027	.035	0.042	-----	-----	-----
3/4	.015	.015	.021	.027	.027	.035	.035	.042	-----	-----	-----
7/16	.015	.015	.021	.027	.027	.035	.042	.042	0.052	-----	-----
1/2	.021	.021	.021	.027	.027	.035	.042	.042	.052	0.073	-----
9/16	.021	.021	.027	.027	.027	.035	.042	.052	.062	.062	-----
5/8	.027	.027	.027	.027	.027	.035	.042	.052	.052	.062	-----
11/16	.027	.027	.027	.027	.027	.035	.042	.052	.052	.062	-----
3/4	.027	.027	.027	.027	.035	.035	.042	.052	.068	.062	-----
13/16	.027	.035	.035	.035	.035	.042	.052	.052	.068	.075	-----
7/8	.035	.035	.035	.035	.042	.042	.052	.062	.068	.075	-----
15/16	.035	.035	.035	.035	.042	.042	.052	.062	.075	.085	-----
1	.035	.035	.042	.042	.042	.042	.052	.062	.075	.085	0.093
1-1/16	.035	.035	.042	.042	.042	.052	.052	.062	.075	.085	-----
1-1/8	.042	.042	.042	.042	.042	.052	.052	.068	.075	.085	-----
1-3/16	.042	.042	.052	.052	.052	.052	.062	.075	.085	.095	0.102
1-1/4	.042	.042	.052	.052	.052	.062	.062	.075	.085	.095	-----
1-5/16	.042	.042	.052	.052	.052	.062	.062	.075	.095	.105	-----
1-3/8	.047	.052	.052	.052	.052	.062	.068	.085	.095	.105	-----
1-7/16	.047	.052	.062	.062	.062	.062	.075	.085	.105	.115	-----
1-1/2	.052	.052	.062	.062	.062	.068	.075	.085	.105	.115	-----
1-9/16	.052	.052	.062	.062	.062	.068	.075	.095	.105	.130	-----
1-5/8	.062	.062	.062	.062	.062	.075	.085	.095	.115	.130	-----
1-11/16	.062	.062	.068	.068	.068	.075	.085	.105	.115	.130	-----
1-3/4	.062	.062	.068	.068	.068	.075	.085	.105	.125	.145	-----
1-13/16	.062	.062	.075	.075	.075	.085	.095	.105	.125	.145	-----
1-7/8	.062	.062	.075	.075	.075	.085	.095	.115	.125	.145	-----
1-15/16	.068	.068	.075	.075	.075	.085	.095	.115	.141	.157	-----
2 incl.	.068	.068	.075	.075	.075	.085	.095	.115	.141	.157	-----
2-3 excl.	.078	.094	.109	.109	.125	.125	.125	.141	.156	.171	0.186
3-4 excl.	.094	.109	.125	.125	.141	.141	.141	.156	.156	.171	.186

1/ Tolerance under specified thickness, 0.01 inch. No single reading shall be below the minimum thickness.
2/ When ultrasonically gauged, the tolerance may be assumed to be average of the variation in gauge measurements.
3/ For intermediate specified thickness, the tolerance of the lower gauge shall apply. In case of mid-point thicknesses, the tolerance for the lower specified gauge or a linearly interpolated value shall apply.

3.4 Fine grain practice for AH-36T and AH-36TZ shapes, plates and bars. AH-36T and AH-36TZ shapes, plates and bars shall be produced using a fine grain practice in accordance with section 43 of the ABS Rules.

3.5 Chemical composition. Unless otherwise specified (see 6.2.1), the chemical composition shall conform to section 43 of the ABS Rules.

3.5.1 Chemical composition of EH-36Z and EH-36TZ. The chemical composition (heat analysis) of EH-36Z and EH-36TZ shall conform to the higher strength steel composition with the following additional limitations:

(a) The maximum sulfur content shall be 0.010 percent.
(b) Additions of elements that result in control of the shape of nonmetallic inclusions (sulfide shape control) shall be made.
(c) When product analysis is specified, chemical tolerances shall be in accordance with ASTM A 6 and shall be applied with the exception that the upper maximum tolerance limit for sulfur and phosphorus shall be 0.003 percent weight.

3.5.2 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used products is allowed under this specification unless otherwise specifically specified.

3.6 Surface finish. Unless otherwise specified (see 6.2.1), plates, shapes, and bars shall be furnished class P (see 1.2.2).

3.7 Internal soundness. Plates ordered to condition T and TZ shall be inspected as specified in appendix A and shall meet the acceptance criteria as specified in appendix A. Shapes and bars ordered to condition T and TZ shall not have a complete loss or transposition of back reflection by more than a total of 6 inches (150 millimeters (mm)) in any 3 feet (1 meter) of scan when tested in accordance with 4.5.2.

3.8 Mechanical properties. Every grade of material shall be tested and certified in accordance with the provisions of section 43 of the ABS Rules. Test results shall meet all mechanical property requirements specified in section 43 of the ABS Rules.

3.8.1 Properties test direction. The mechanical properties shall be obtained in the transverse direction unless size limitations require obtaining them in the longitudinal direction.

3.8.2 Through thickness properties of EH-36Z and EH-36TZ. The reduction in area shall be not less than 20 percent when tested as specified in 4.5.3.

3.9 Identification. Each grade of material shall be marked in accordance with section 43 of the ABS Rules and in accordance with the following additional requirements:

(a) Steel plates, shapes, and bars over 3/8 inch in thickness shall be steel die stamped with the appropriate classification (see 1.2) and with the letters "AB".
(b) Plates 3/8 inch and less in thickness shall be stencilled with the appropriate classification (see 1.2).
(c) Shapes and bars less than 3/8 inch in thickness shall be identified by stencilling or tagging, depending on the available surface area.

The specification number shall be included on each plate, shape, or bar. For materials over 3/8 inch in thickness, the specification number shall be stamped or stencilled.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Certification of quality conformance. When specified in the contract or order, certification data for level 1 material shall be prepared (see 6.2.2 and appendix C).

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall be conducted in accordance with section 43 of the ABS Rules which requires data in support of mechanical properties, weldability, and compliance with the rules when new or

special steel or production methods are proposed or when new steel mills begin production. Approval by ABS to produce a particular grade of ABS steel also approves the facility to produce the same grade of steel to this specification.

4.3.1 First article inspection report. When specified in the contract or order, a first article inspection procedure and report shall be prepared (see 6.2.2).

4.3.2 First article inspection of Z grades. First article inspection shall be performed on each type and thickness range of Z and TZ grades of steel to approve any contractor who has not previously supplied these grades to this specification. First article inspection shall include all tests specified in section 43 of the ABS Rules and the additional tests specified in 4.3.2.1 through 4.3.2.3. Thickness ranges shall be up to 1 inch (25 mm), over 1 inch (25 mm) to 2 inches (51 mm), over 2 inches (51 mm) to 4 inches (102 mm), and over 4 inches (102 mm) to 6 inches (152 mm). First article inspection will be verified by the ABS surveyor.

4.3.2.1 Tensile tests. Tensile tests shall be performed in accordance with ASTM A 370 on specimens taken parallel, and transverse, to the direction of rolling, and taken in accordance with ASTM A 770 or specimens taken in the thickness direction.

4.3.2.2 Transition temperature movement. The nil-ductility transition temperature shall be determined in accordance with ASTM E 208.

4.3.2.3 Charpy V-notch impact test. Charpy V-notch impact tests shall be performed in accordance with section 43 of the ABS rules on one set of specimens taken parallel to and one set of specimens taken transverse to the direction of rolling at each of the following temperatures: minus 60 degrees Fahrenheit (°F) (minus 50 degrees Celsius (°C)), minus 40°F (minus 40°C), 32°F (0°C), and 70°F (21°C). The tolerance on each temperature shall be plus or minus 3°F (plus or minus 1.7°C). Each set of specimens shall consist of a minimum of three specimens.

4.3.3 First article inspection of grades T and TZ. First article inspection shall be performed using the UT inspection procedures for grades T and TZ for steel mills which previously have not met first article test requirements for grades requiring UT testing in superseded specifications (see 6.4).

4.3.3.1 Plate. Unless other requirements are specified (see 6.2.1), a UT test procedure meeting the requirements of 3.7 and appendix A shall be demonstrated to the ABS surveyor for the first article inspection of grades T and TZ plate material.

4.3.3.2 Shapes and bars. An UT test procedure meeting the requirements of 3.7, 4.5.2 and appendix A shall be demonstrated for the first article inspection of grades T and TZ shapes and bars.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests as specified in 4.5.1, 4.5.2, and 4.5.3.

4.4.1 Sampling for quality conformance inspection and test. The sampling for inspection and test shall be performed as specified in section 43 of ABS Rules.

4.5 Tests.

4.5.1 Chemical analysis and mechanical property tests. The chemical analysis and mechanical property tests shall be conducted as specified in section 43 of the ABS Rules.

4.5.1.1 Standard test specimen. The mechanical test specimens shall be taken in the transverse direction unless the size of the base material prohibits the taking of transverse specimens. When transverse specimens cannot be taken, longitudinal shall be obtained.

4.5.2 UT test of grades T and TZ shapes and bars. Each grade T and TZ shape or bar with a minimum thickness of more than 1/2 inch shall be UT tested by a procedure qualified in accordance with the requirements for plates in MIL-STD-271. The procedure shall employ a frequency of not less than 2.25 megahertz (MHz) with a crystal diameter of not more than 1-1/8 inches. "H" beams shall require a minimum of two longitudinal continuous scans, one centered along two web flange intersections on the outside surface of both flanges (see figure 1). Tee shapes shall require one longitudinal scan centered along the web flange intersection on the outside of the flange (see figure 1). The bar shapes shall require one or more longitudinal scans to provide 100 percent coverage (see figure 1).

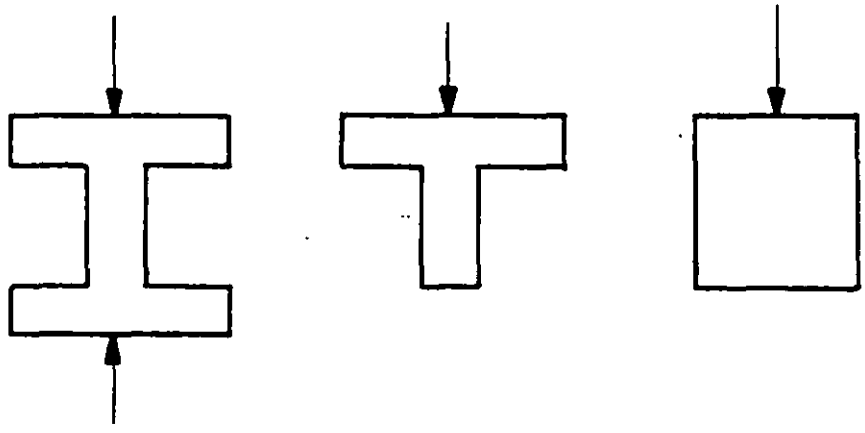

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FIGURE 1. Location of ultrasonic scans.

4.5.3 Through thickness tensile test of Z and TZ grade plates.

4.5.3.1 Specimens. Through thickness tensile test specimens shall be taken from each plate as rolled which has a thickness 1 inch and over.

4.5.3.2 Conduct of test. The through thickness tensile test shall be conducted in accordance with ASTM A 770.

4.5.3.3 Reduction of area. The reduction of area shall be calculated using the following formula:

$$\text{Percent reduction of area} = \frac{(\text{initial diameter})^2 - (\text{final diameter})^2}{(\text{initial diameter})^2} \times 100$$

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Preservation, packing and marking. Structural plates, shapes, and bars shall be preserved, packed, and marked in accordance with ASTM A 700 (see 6.2.1).

5.2 Class P material. Class P material shall be cleaned and preserved in accordance with appendix B.

6. NOTES

6.1 Intended use. Material covered by this specification is intended for use in U.S. Navy ship hull and structure. Grades EH-36T and AH-36T are intended for critical applications. Grades EH-36Z and EH-36TZ are intended for use in applications with through thickness loading where lamellar tearing has been a problem.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Grade specified (see 1.2.1 and 3.2).
(c) Class required (see 1.2.2).
(d) When first article is required (see 3.1).
(e) Dimensional tolerances required (see 3.3).
(f) When chemical composition is other than specified (see 3.5).
(g) When surface finish is other than class P (see 3.6).

(h) Deviations in UT inspection method or UT acceptance criteria from appendix A of grade T plate, shapes, and bars (see 4.3.3.1).
(i) Level of preservation, packing, and marking required (see 5.1).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

Paragraph no.	Data requirement title	Applicable DID no.	Option
4.1.2 and appendix C	Certification data for level I material	UDI-T-23191	---
4.3.1	First article inspection procedure	DI-T-4901	----
4.3.1	First article inspection report	DI-T-4902	---
Appendix A, 30.2	Reports, test	DI-T-2072	---

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 First article. When a first article inspection is required, the item should be a first article sample. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Supersession data. This specification supersedes MIL-S-22698B(SHIPS), MIL-S-16113C(SHIPS), MIL-S-20166B, and MIL-S-24113A(SHIPS) with applicable grades and classes as shown in table II.

TABLE II. Supersession data.

Current specification	Superseded plate specifications		
MIL-S-22698C	MIL-S-22698A	MIL-S-16113	MIL-S-24113A
Grade A (1/2 inch (13 mm) and less)	Class A		
Grade B	Class B		
Grade D	Class C		
Grade DH-36	Class D	Grade HT-type I	Grade N
Grade EH-36T		Grade HT-type II	Grade N
ASTM A 537			Grade QT[1]

Current specification	Superseded bar and shape specification
MIL-S-22698C	MIL-S-20166
Grade A (3/4 inch and less)	Grade M
Grade B	Grade M
Grade AH-36	Grade HT-type I
Grade AH-36T	Grade HT-type II
Grade A or B	Grade F and C

[1] MIL-S-24113, grade QT is no longer used; use ASTM A 537, class 2, for plates over 1/2 inch (13 mm). A set of three Charpy V-notch impact specimens should provide an average value of 30 foot-pounds when tested at minus 10°F (minus 23°C).

6.4.1 Alternate specifications. This material may also be acquired using the commercial specifications shown in table III. If the additional requirements shown in table III are met, material acquired under these commercial specifications may be used as a substitute for the material specified herein.

TABLE III. Cross reference data.

Current specification MIL-S-22698C	Equivalent commercial specifications	Requirements in addition to commercial specifications[1] [2]
Grade B	Bars for reforging ASTM A 576, grade 1022 ASTM A 131, grade B	Si 0.15 to 0.35
Grade DH-36	ASTM A 541, class 4 ASTM A 131, grade DH-36	
Grade A (3/4 inch (19 mm) and less)	Bars and bar size shapes ASTM A 36	Limited to 3/4 inch and below.
Grade B	ASTM A 576 ASTM A 29, grades 1015 thru 1022 (fine grain melt practice) ASTM A 131, grade A or B	Si 0.15 to 0.35
Grade AH-36	ASTM A 322, class 8620 fine grained, normalized ASTM A 131, grade AH-36 ASTM A 588, grades A, B	
Grade EH-36	ASTM A 131, grade EH-36	

[1] ABS verification of test data required in all cases.
[2] Commercial specifications selected as being capable of meeting MIL-S-22698 requirements, but in all cases Charpy V-notch and mechanical properties should be shown to meet the requirements of MIL-S-22698.

6.4.2 The following mechanical property and chemical composition tables are excerpts reproduced from Rules for Building and Classing Steel Vessels of the American Bureau of Shipping. Tables IV through X are for information only and are subject to revision.

TABLE IV. Requirements for ordinary-strength hull structural steel, grades A, B, D, E, DS, CS, 51 mm (2 inches) and under.

Grades	A	B	D	E	DS	CS
Deoxidation	Any method except rimmed steel for material over 12.5 mm (0.5 in)	Any method except rimmed steel	Fully killed fine-grain practice[1]	Fully killed fine-grain practice	Fully killed fine-grain practice	Fully killed fine-grain practice
Chemical composition (ladle analysis)	For all grades exclusive of grade A shapes and bars, the carbon content plus 1/6 of the manganese content is not to exceed 0.40 percent. The upper limit of manganese may be exceeded up to a maximum of 1.65 percent provided this condition is satisfied.					
Carbon (percent)	0.23 max[2]	0.21 max	0.21 max	0.18 max	0.16 max	0.16 max
Manganese (percent)	2.5x carbon min for plates over 12.5 mm (0.5 in)	0.80-1.10 0.60 min for fully killed or cold flanging	0.70-1.35 0.60 min for thickness 25 mm (1.0 in) and under	0.70-1.35	1.00-1.35	1.00-1.35
Phosphorus (percent)	0.04 max	0.04 max	0.04 max	0.04 max	0.04 max	0.04 max
Sulphur (percent)	0.04 max	0.04 max	0.04 max	0.04 max	0.04 max	0.04 max
Silicon (percent)	---	0.35 max	0.10-0.35	0.10-0.35	0.10-0.35	0.10-0.35
Tensile test						
Tensile strength	For all grades: 41-50 kg/mm^2 (58,000-71,000 lb/in^2); for grade A shapes and bars 41-56 kg/mm^2 (58,000-80,000 lb/in^2). For cold flanging quality: 39-46 kg/mm^2 (55,000-65,000 lb/in^2).					

See footnotes at end of table.

TABLE IV. Requirements for ordinary-strength hull structural steel, grades A, B, D, E, DS, CS, 51 mm (2 inches) and under. - Continued

Grade	A	B	D	E	DS	CS
Yield point, min	For all grades: 24 kg/mm^2 (34,000 lb/in^2); for grade A over 25.0 mm (1.0 in) in thickness 23 kg/mm^2 (32,000 lb/in^2). For cold flanging quality: 21 kg/mm^2 (30,000 lb/in^2).					
Elongation, min	For all grades: 21 percent in 200 mm (8 in) or 24 percent in 50 mm (2 in) or 22 percent in 5.65 A (A equals cross-sectional area of test specimen). For cold flanging quality: 23 percent min in 200 mm (8 in).					
Impact test, Charpy V-notch	For grades:	B	D	E		
Temperature		0°C (32°F) Over 25 mm (1.0 in)	minus 10°C (14°F)	minus 40°C (minus 40°F)		
Energy avg. min Longitudinal specimens or Transverse specimens		2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)[3]	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)		
Heat treatment			Normalized over 35 mm (1.375 in) thick[4]	Normalized[6]	Normalized over 35 mm (1.375 in)	Normalized
Marking	AB/A	AB/B	AB/D[5]	AB/E	AB/DS	AB/CS

See footnotes at top of next page.

[1] Grade D may be furnished semi-killed in thickness up to 35 mm (1.375 inches) provided steel above 25.0 mm (1.00 inch) in thickness is normalized. In this case the requirements relative to minimum Si and Al contents and fine grain practice do not apply.

[2] A maximum carbon content of 0.26 percent is acceptable for grade A plates equal to or less than 12.5 mm (0.5 inch) and all thicknesses of grade A shapes and bars.

[3] Impact tests are not required for normalized grade D steel when furnished fully killed fine grain practice.

[4] Controlled rolling or thermo-mechanical controlled rolling of grade D steel may be specially considered as a substitute for normalizing.

[5] Grade D hull steel which is normalized, thermo-mechanical controlled rolled, or controlled rolled in accordance with note 4 is to be marked AB/DN.

[6] Controlled rolling or thermo-mechanical controlled rolling of grade E shapes and thermo-mechanical controlled rolling of grade E plates may be specially considered as a substitute for normalizing.

TABLE V. Requirements for ordinary-strength hull structural steel over 51 mm (2 inches).

Process of manufacture: open hearth, basic oxygen, or electric furnace.

Grades	A	B	D	DS	CS	E
Impact test, Charpy V-notch temperature	20°C[1] (68°F)	0°C (32°F)	minus 10°C (14°F)	minus 10°C (14°F)	minus 40°C (minus 40°F)	minus 40°C (minus 40°F)
Energy avg. min Longitudinal specimens or Transverse specimens	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)	2.8 kg-m (20 ft-lbs) 2.0 kg-m (14 ft-lbs)
No. of specimens	3 from each[1] 50 tons	3 from each 50 tons	3 from each 50 tons	3 from each 50 tons	3 from each plate	3 from each plate
Heat treatment	None required	None required	Normalized	Normalized	Normalized	Normalized
Deoxidation	Fully killed	Fully killed	Fully killed fine-grain practice	Fully killed fine-grain practice	Fully killed fine-grain practice	Fully killed fine-grain practice

[1]Impact tests for grade A are not required when material is produced using a fine grain practice and normalized.

TABLE VI. Charpy V-notch impact test frequency for ordinary strength hull structural steel grades B, D, and E, when impact testing is required.

			When specially approved as a substitute for normalizing	
Grade	As rolled	Normalized	Controlled rolled	Thermo-mechanical controlled rolled
B	Each 50 tons from each heat for plates and sections.	---	---	---
D	Each 50 tons from each heat for plates and sections.	Each 50 tons from each heat for plates and sections.	Each 25 tons from each heat for plates and sections.	Each 25 tons from each heat for plates and sections.
E	Not permitted.	Each plate. Each 25 tons from each heat for sections.	Not permitted for plates. Each 15 tons from each heat for sections.	Each plate. Each 15 tons from each heat for sections.

TABLE VII. Requirements for higher-strength hull structural steel, grades AH32, DH32, EH32, AH36, DH36, and EH36, 51 mm (2 inches) and under.

Process of manufacture: open hearth, basic oxygen, or electric furnace

Grades[1]	AH32	DH32	EH32	AH36	DH36	EH36
Deoxidation	Semi-killed or killed[3]	Killed, fine grain practice[4]	Killed, fine grain practice[4]	Semi-killed or killed[3]	Killed, fine grain practice[4]	Killed, fine grain practice[4]
Chemical composition for all grades (ladle analysis)						
Carbon, percent	0.18 max					
Manganese, percent[2]	0.90-1.60					
Phosphorus, percent	0.04 max					
Sulfur, percent	0.04 max					
Silicon, percent[3]	0.10-0.50					
Nickel, percent	0.40 max					
Chromium, percent	0.25 max					
Molybdenum, percent	0.08 max					
Copper, percent	0.35 max					
Columbium, percent (niobium)	0.05 max	These elements need not be reported on the mill sheet unless intentionally added.				
Vanadium, percent	0.10 max					
Tensile test						
Tensile strength	48-60 kg/mm^2; 68,000-85,000 lb/in^2			50-63 kg/mm^2; 71,000-90,000 lb/in^2		
Yield point or yield strength, min	32 kg/mm^2; 45,500 lb/in^2			36 kg/mm^2; 51,000 lb/in^2		
Elongation, min	For all grades: 19 percent in 200 mm (8 in) or 22 percent in 50 mm (2 in) or 20 percent in 5.65 A (A equals area of test specimen)					

TABLE VII. Requirements for higher-strength hull structural steel, grades AH32, DH32, EH32, AH36, DH36, and EH36, 51 mm (2 inches) and under. - Continued

Grades[1]	AH32	DH32	EH32	AH36	DH36	EH36
Impact test Charpy V-notch Temperature	0°C (32°F)	minus 20°C (minus 4°F)	minus 40°C (minus 40°F)	0°C (32°F)	minus 20°C (minus 4°F)	minus 40°C (minus 40°F)
Energy, avg. min Longitudinal specimens	3.5 kg-m (25 ft-lb)[5]	3.5 kg-m (25 ft-lb)[5]	3.5 kg-m (25 ft-lb)	3.5 kg-m (25 ft-lb)[5]	3.5 kg-m (25 ft-lb)[5]	3.5 kg-m (25 ft-lb)
or Transverse specimens	2.4 kg-m (17 ft-lb)[5]	2.4 kg-m (17 ft-lb)[5]	2.4 kg-m (17 ft-lb)	2.4 kg-m (17 ft-lb)[5]	2.4 kg-m (17 ft-lb)[5]	2.4 kg-m (17 ft-lb)
Marking	AB/AH32	AB/DH32[6]	AB/EH32	AB/AH36	AB/DH36[6]	AB/EH36

[1] The numbers following the grade designation indicate the yield point or yield strength to which the steel is ordered and produced in kg/mm^2.

[2] Grade AH 12.5 mm (0.50 inch) and under in thickness may have a minimum manganese content of 0.70 percent.

[3] Grade AH plates to 12.5 mm (0.50 inch) inclusive may be semi-killed in which case the 0.10 percent minimum silicon does not apply. Unless otherwise approved, grade AH plates over 12.5 mm (0.50 inch) are to be killed with 0.10 to 0.50 percent silicon.

[4] Grades DH and EH are to contain at least one of the grain refining elements in sufficient amount to meet the fine grain practice requirement.

[5] Impact tests are not required for AH, 12.5 mm (0.5 inch) and less in thickness, and aluminum treated grade AH, 35 mm (1.375 inches) and less in thickness. Impact tests are not required for any fully killed, fine grain normalized grade AH, or DH, 51 mm (2 inches) and less in thickness.

[6] The marking AB/DHN is to be used to denote grade DH plates which have either been normalized, thermo-mechanical controlled rolled or control rolled in accordance with an approved procedure.

TABLE VIII. Requirements for higher-strength hull structural steel over 51 mm (2 inches).

Process of manufacture: open hearth, basic oxygen, or electric furnace

Grades	AH 32 and 36	DH 32 and 36	EH 32 and 36
Impact test Charpy V-notch Temperature	0°C (32°F)	minus 20°C (minus 4°F)	minus 40°C (minus 40°F)
Energy avg. min Longitudinal specimens or Transverse specimens	3.5 kg-m (25 ft-lbs) 2.4 kg-m (17 ft-lbs)	3.5 kg-m (25 ft-lbs) 2.4 kg-m (17 ft-lbs)	3.5 kg-m (25 ft-lbs) 2.4 kg-m (17 ft-lbs)
No. of specimens	3 from each 50 tons	3 from each 50 tons	3 from each plate
Heat treatment	Normalized	Normalized	Normalized

TABLE IX. Charpy V-notch impact test frequency for higher strength hull structural steel, grades AH32, DH32, EH32, AH36, DH36, and EH36, when impact testing is required.

			When specially approved as a substitute for normalizing	
Grade	As rolled	Normalized	Controlled rolled	Thermo-mechanical controlled rolled
AH	Each 50 tons from each heat for plates and sections	Each 50 tons from each heat for plates and sections	Each 50 tons from each heat for plates and sections	Each 50 tons from each heat for plates and sections
DH	Each 50 tons from each heat for plates and sections	Each 50 tons from each heat for plates and sections	Each plate. Each 25 tons from each heat for sections	Each plate. Each 25 tons from each heat for sections
EH	Not permitted	Each plate. Each 25 tons from each heat for sections	Not permitted for plates. Each 15 tons from each heat for sections	Each plate. Each 15 tons from each heat for sections

TABLE X. Normalizing heat treatment requirements for higher strength hull structural steels.

Grade	AH	DH[1]	EH[3]
Aluminum treated steels	Over 51 mm (2 in) thick	Over 25.5 mm (1 in) thick	All thicknesses
Columbium[2] or vanadium	Over 51 mm (2 in) thick	Over 12.5 mm (0.5 in) thick	All thicknesses

[1] Controlled rolling or thermo-mechanical controlled rolling of grade DH may be specially considered as a substitute for normalizing.

[2] When columbium (niobium) or vanadium are used in combination with each other or with aluminum, the heat treatment requirements for columbium (niobium) or vanadium apply.

[3] Controlled rolling or thermo-mechanical controlled rolling of grade EH shapes and thermo-mechanical controlled rolling of grade EH plates may be specially considered as a substitute for normalizing.

6.5 Subject term (key word) listing.

Charpy V-notch impact test
Rules, building and classing (American Bureau of Shipping)
Ultrasonic testing

6.6 Approved sources. Steel mills which have met first article test requirements of superseded specifications (see 6.4) or which have ABS source approval are to be considered as approved sources for the Navy, for the equivalent grades listed in 1.2.1 and table II, provided approval is maintained in accordance with section 43 of the ABS Rules. Steel mills which do not have ABS approval and which have met first article requirements of superseded specifications should obtain ABS source approval. New sources or existing sources which modify production processes should obtain approval in accordance with section 43 of the ABS Rules, and in addition, should obtain approval from the Commander, Naval Sea Systems Command, Materials and Assurance Engineering Office, Department of the Navy, Washington, DC 20362.

6.7 International interest. Certain provisions of this specification are the subject of international standardization agreement ABCA-NAVSTAG-54A. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices to change the agreement or make other appropriate accommodations.

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 9515-N045)

APPENDIX A

ULTRASONIC TESTING

10. SCOPE

10.1 Scope. This appendix describes the minimum requirements and basic methods of UT testing and gauging for service acceptability. It shall in no way restrict the supplemental use of other tests, where the application requires them, nor define or otherwise determine acceptability of these tests, nor address repair. This appendix forms a mandatory part of the specification.

10.2 Background. Specialized applications require control beyond that commonly required for other structural application. These tests are intended to assure freedom from lamination, and excessive nonmetallic inclusions.

20. APPLICABLE DOCUMENTS

Not applicable.

30. APPLICATION

30.1 These methods shall be used when UT testing material produced to this specification.

30.2 When specified in the contract or order, test reports shall be prepared (see 6.2.2). The results of tests shall be attested to by an ABS surveyor or other Government representatives.

40. ULTRASONIC GAUGING

40.1 Equipment. Either pulse echo or resonance frequency equipment may be employed.

40.1.1 Calibration of equipment. Calibration of UT gauging equipment shall be performed as follows:

(a) Pulse echo instruments. A number of readings shall be made on several test blocks within the range of each calibration of the instrument. Variation between the true thickness and the measured thickness shall be reduced to plus or minus percentage variation and this value plotted on a graph (see figure 2). Plus or minus variation from zero shall be plotted on the horizontal axis and the percent of readings plotted on the vertical axis. A minimum number of ten readings shall be made to accurately determine the thickness testing characteristics of the instruments.

(b) Resonance frequency thickness testing instrument. The method of determining limits of accuracy on a resonance frequency instrument shall be similar to that indicated in (a) above except that one instrument calibration may be made for any number of thicknesses. The graph shall be plotted on a percentage basis showing limits of accuracy as specified in (a) above and shown on figure 2.

(c) Limits of accuracy. Accuracy of all UT thickness testing instruments shall be such that 95 percent of the total number of readings will be within plus or minus 3 percent of the true value.

(d) Frequency of calibration. Pulse echo instruments shall be calibrated at intervals of not greater than 1 month. If the instrument is checked against a standard thickness test block each time it is used and accuracy is within acceptable limits of plus or minus 3 percent, full instrument calibration may be extended to once every 6 months. Micrometer gauged spots on the plates being tested are considered standard thickness blocks provided they are sufficiently free from discontinuities that a prominent back reflection will be displayed on the cathode ray tube (CRT).

(e) Resonance frequency instruments. Resonance frequency instruments shall be calibrated prior to each use.

(f) UT testing operators and inspectors shall be thoroughly familiar with the operation and calibration of the equipment used. They shall demonstrate their ability to operate and calibrate the instrument as specified herein. They shall also be thoroughly familiar with inspection requirements and acceptance standards as specified herein.

40.2 Ultrasonic gauging procedure.

40.2.1 Thickness shall be measured by a micrometer at three evenly distributed points along each longitudinal edge and at two evenly distributed points along each transverse edge.

40.2.2 Material shall be gauged at each intersection of a 24-inch grid pattern using an UT gauging device.

40.2.3 If mechanized scanning is employed, the average of the readings obtained on 24-inch scan lines may be used.

40.3 UT gauging acceptance-rejection criteria. Thickness determinations of each grid intersection shall be averaged (arithmetical mean). Material shall exhibit an average gauge thickness within the tolerance specified in 3.3.

50. UT TESTING FOR INTERNAL SOUNDNESS

50.1 UT test equipment. UT inspection equipment shall consist of an electronic apparatus that produces, receives and displays high frequency electrical pulses at the required frequencies (2.25 hertz) and energy levels, with search units with wedges to minimize the effects of reflecting internal waves, and a 1-1/8 inch diameter quartz crystal, that shall reversibly transduce electrical energy to mechanical vibrations at the required frequencies and energy levels, and as specified in section 40 herein.

50.2 UT test equipment calibration. A straight beam search unit, that transmits a longitudinal wave mode into the plate under test, shall be placed on an experimentally determined defect-free area. The instrument shall then be adjusted to display, with maximum resolution, a prominent scale-10 first back reflection indication on the CRT, over which a transparent overlay has been placed. The overlay shall be adjusted as shown on figure 3. The transparent overlay having both horizontal and vertical linear markings shall be superimposed on the face of the CRT (see figure 3). The vertical scale shall be marked from zero to 10 in increments of 1 inch, and shall be placed so that zero coincides with the horizontal trace, and 10 falls at some point between 90 and 100 percent of full screen height. The horizontal scale shall consist of a convenient number of equispaced markings, one of which shall coincide with the first back reflection. Any indication shall then be read directly and referred to in terms of scale height. If scale-10 represents 100 percent, any indication may be stated as a percentage by adding a zero to the scale reading. Nomenclature, as used in this specification, is shown on figure 4.

50.3 Surface preparation. The surface shall be in the pickled or abrasive blasted condition and the surface may have one coat of primer. The test surface shall be free of dirt, rust, or any foreign substance which may interfere with the test. Surface conditions of the test areas shall be sufficiently smooth so that a scale-10 first back reflection, as specified in 50.2 is displayed on the CRT. If necessary, conditioning of the test areas shall be accomplished by mechanical means, such as grinding or belt sanding. An appropriate liquid, semi-liquid or paste, such as water, oil, glycerine, or grease, shall be used as a coupling medium.

50.4 UT test procedure. Using equipment, calibration methods and straight beam wave, testing shall be in accordance with the following procedure:

50.4.1 Plates over 1/2 through 2-1/2 inches thick shall be UT tested at the intersections of a 24-inch grid pattern.

50.4.2 Plates over 2-1/2 inches thick shall be UT tested on the lines of a 24-inch grid pattern and one diagonal in each square formed by the grid.

50.4.3 When defects are encountered that result in a loss of normal back reflection of 50 percent or more, or the defect exhibits an indication that results in a loss of back reflection equal to 50 percent or more of the height of the normal back reflection, the surrounding area shall be scanned over 100 percent of the surface within a 1-foot radius of the original defect.

50.4.4 The testing procedure for shapes and bars shall be as specified in 4.5.2.

50.5 Ultrasonic acceptance-rejection standards.

50.5.1 Definitions of ultrasonic defects. Definitions of ultrasonic defects are as follows:

(a) Lamination. Lamination is a discontinuity indicated by a shift in back reflection of a size 4 square inches or greater as shown on figure 5.

(b) Large segregation. Large segregation is a discontinuity resulting in shift of back reflection or reduction of back reflection by more than 50 percent with an attendant pip of 50 percent or more of normal back reflection height. This is judged by the crystal movement of one crystal diameter in any direction and such discontinuity is less than 4 square inches in size (see figure 6).

(c) Small segregation. Small segregation is a discontinuity which will not result in a complete shift and may or may not result in reduction of back reflection with a significant pip or pips equivalent to 50 percent or less of the height of the back reflection (see figure 7).

50.5.2 Plates, shapes, or bars exhibiting one or more laminations (see 50.5.1) are not acceptable.

50.5.3 Plates, shapes, or bars exhibiting two or more large segregations (see 50.5.1(b)) equal to or in excess of the following are not acceptable:

(a) Two large segregations in a 1-square foot area lying in planes that are within 1/8 inch of each other. Ultrasonically, the relative planar position of defects shall be determined by the proximity of indications on the base line of the CRT.

50.5.4 Small segregations (see 50.5.1(c)) are acceptable.

50.5.5 Cropping to remove defective areas is permitted.

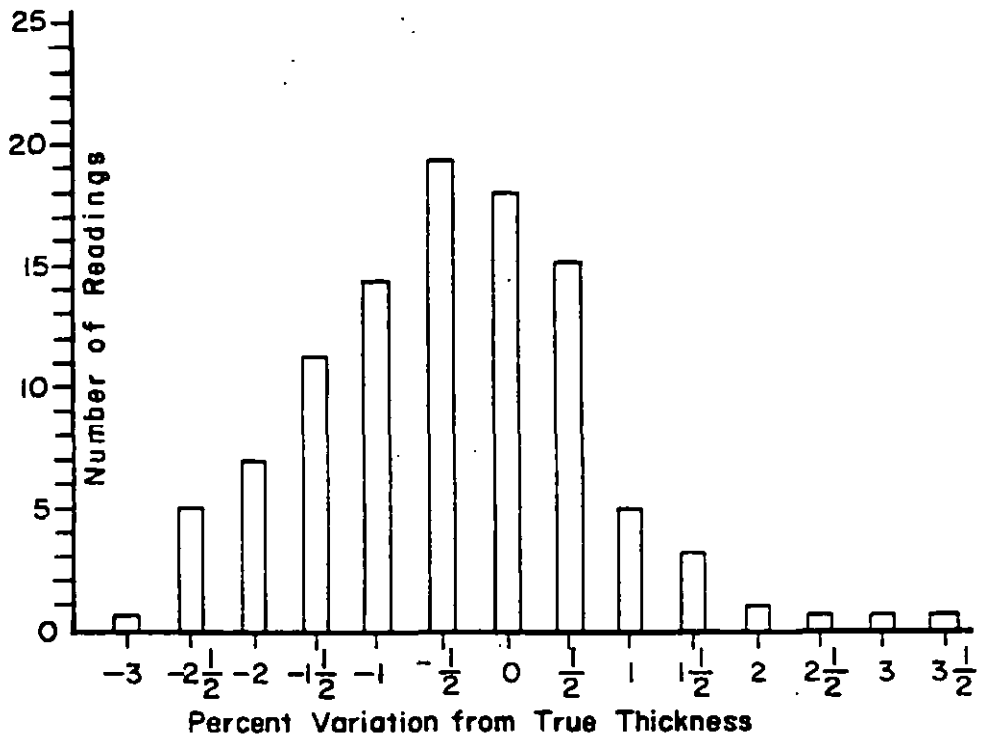


FIGURE 2. Calibration of ultrasonic instrument for thickness testing.

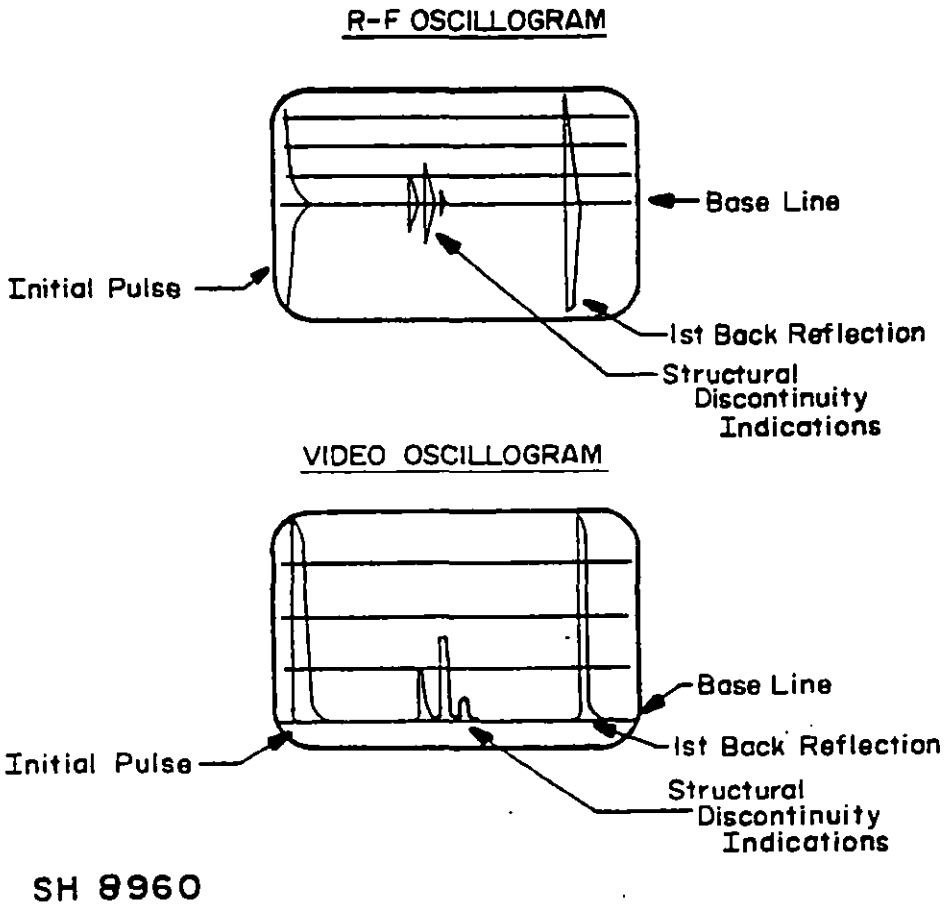


FIGURE 3. CRT transparent overlay scales.

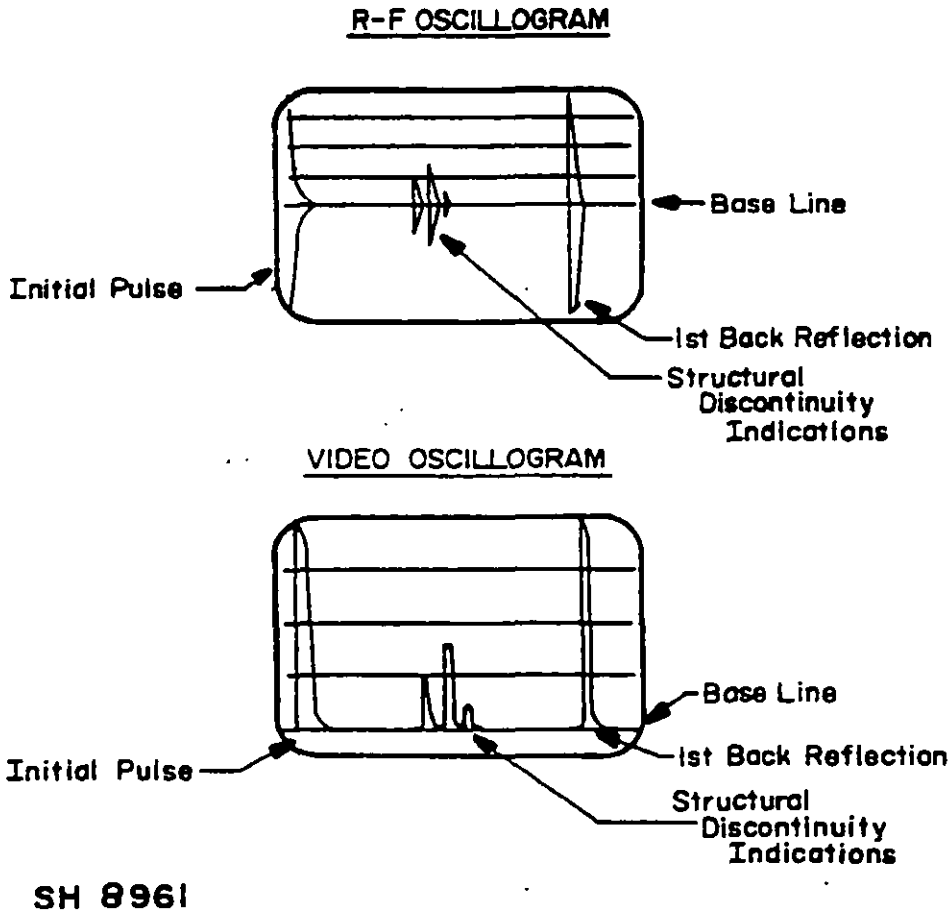
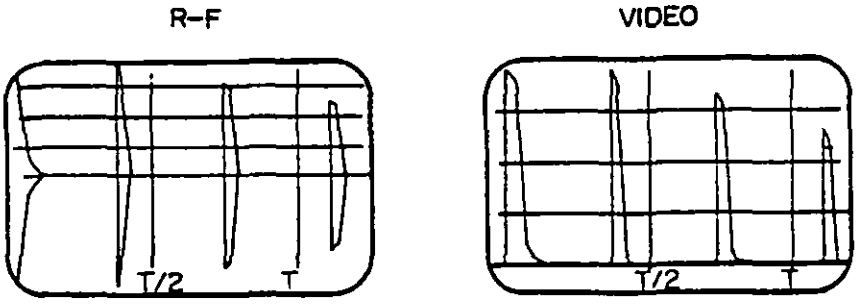
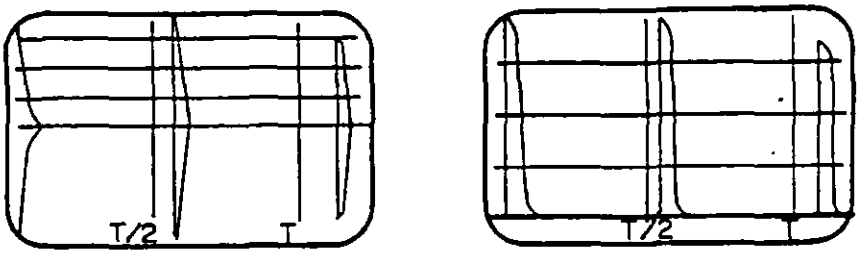


FIGURE 4. Oscillogram nomenclature for steel plate.



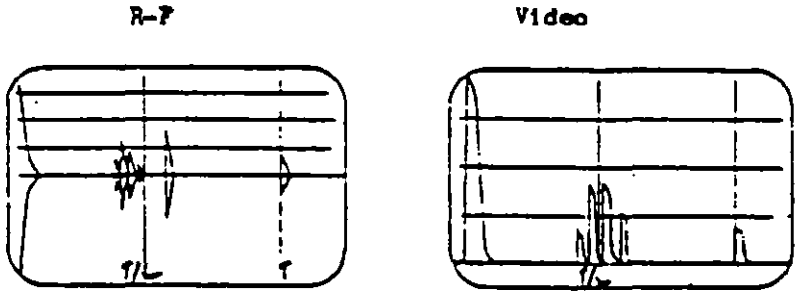
Lamination at a depth less than T/2 from the test surface.



Lamination at a depth greater than T/2 from the test surface.

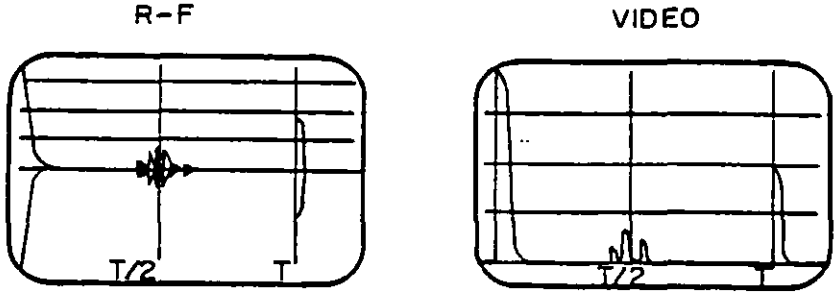
SH 8962

FIGURE 5. Oscillograms of typical laminations.



SH 8963

FIGURE 6. Example of large segregations without shift of back reflection.



SH 8964

SH 8964

FIGURE 7. Example of 50 percent reduction in back reflection with small laminar segregations.

APPENDIX B

CLEANING AND PRESERVING PROCEDURES

10. SCOPE

10.1 Scope. This appendix outlines the cleaning and preserving procedures for ship structural steel plates, shapes, and bars. This appendix forms a mandatory part of the specification.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications and standard. The following specifications and standard form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

TT-P-645	- Primer, Paint, Zinc Chromate, Alkyd Type.
TT-P-664	- Primer Coating, Synthetic, Rust-Inhibiting, Lacquer-Resisting.
TT-P-1757	- Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity.

MILITARY

DOD-P-15328	- Primer (Wash), Pretreatment (Formula No. 117 for Metals). (Metric)
MIL-P-15930	- Primer Coating, Shipboard, Vinyl-Zinc Chromate (Formula No. 120).

STANDARD

FEDERAL

FED-STD-595 - Colors.

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

20.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

STEEL STRUCTURES PAINTING COUNCIL (SSPC)
SP 6 - Commercial Blast Cleaning. (DoD adopted)

(Application for copies should be addressed to the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

30. DESCALING AND CLEANING

30.1 Descaling. Material shall be descaled by abrasive blast cleaning or acid pickling.

30.2 Abrasive blast cleaning. Abrasive blast cleaning shall result in a clean metal surface, suitable for painting, equivalent to a commercial blast cleaning, SSPC SP 6.

30.3 Acid pickling. The acid pickling process shall be as follows:

(a) Material shall be tilted on edge throughout the steps of the procedure. Shapes shall not be positioned as to have a lower surface horizontal in the solution.
(b) Rust preventives, oils, greases, oil paints, and other foreign matter shall be removed from the steel prior to pickling.
(c) The pickling bath shall consist of sulphuric acid solution to which has been added a pickling inhibitor and 1-1/2 percent of sodium chloride. In making the solution initially, 5 gallons of concentrated sulphuric acid are to be used for each 100 gallons of solution. The acid concentration shall not be allowed to drop below 3.5 percent by volume. The inhibitor shall be used at the concentration recommended by the manufacturer. The bath temperature shall be maintained between 170 and 180°F. When the concentration of iron in the solution reaches 5 percent by weight, the entire bath shall be discarded. The steel shall be thoroughly rinsed with water after pickling.
(d) The water rinse shall consist of fresh circulating water maintained at a temperature of 170 to 180°F. The flow of fresh water shall be maintained so that a complete change of water occurs at least once every 24 hours. The combined concentrations of sulphuric acid and iron sulphate in the bath, calculated from the acid concentration and the ferrous iron concentration, shall not exceed 2 grams per gallon. This determination shall be made at least once each week.

30.4 Coating. The steel material, as prepared for coating, shall be in the descaled and cleaned condition and free of visible rust. The paint film shall be sufficient to cover surface roughness peaks. Material shall be coated as follows:

30.4.1 Grades A, B, D, and E (yellow coat):

(a) One coat of pretreatment coating in accordance with formula no. 117 of DOD-P-15328, to an approximate dry film thickness of 0.3 to 0.5 mil, followed by one coat of vinyl zinc-chromate primer in accordance with formula no. 120 of MIL-P-15930, altered by removing the lampblack in the formulation to yield a clear yellow color (approximate color no. 33481 (yellow)) in accordance with FED-STD-595. The dry film thickness for the formula no. 120 coat shall be approximately 1.5 to 2.0 mils. The total dry film thickness of the formula no. 117 and formula no. 120 coats shall be approximately 2 mils and the total thickness at any one point shall be not less than 1.5 mils, or

(b) One coat of zinc chromate primer in accordance with formula no. 84 of TT-P-645, clear yellow color approximating color no. 33481 in accordance with FED-STD-595. The dry film thickness shall be approximately 1.5 to 2.0 mils, and shall be not less than 1.5 mils at any one point, or

(c) One coat of synthetic primer in accordance with TT-P-1757, modified to a yellow color (approximately color no. 33481 (yellow) in accordance with FED-STD-595). The dry film thickness shall be approximately 1.5 to 2.0 mils and shall be not less than 1.5 mils at any one point.

30.4.2 Grades AH-36, AH-36T, DH-36, EH-36, EH-36Z, EH-36T, and EH-36TZ (dark green coat):

(a) One coat of pretreatment coating in accordance with formula no. 117 of DOD-P-15328, to an approximate dry film thickness of 0.3 to 0.5 mil, followed by one coat of vinyl zinc-chromate primer, in accordance with formula no. 120 of MIL-P-15930, modified as necessary, with sufficient and insoluble inorganic pigments to produce a dark green color in accordance with no. 34128 (dark green) of FED-STD-595. The dry film thickness for the formula no. 120 coat shall be approximately 1.5 to 2.0 mils. The total dry thickness of formula no. 117 and formula no. 120 coats shall be approximately 2 mils and the total thickness at any one point shall be not less than 1.5 mils, or

(b) One coat of alkyd primer, formula 84D (dark green), conforming to TT-P-645, modified to a color conforming to color no. 34128 (dark green) of FED-STD-595 to an average dry film thickness of approximately 1 mil. The thickness of the dry film shall be not less than 0.7 mil at any point, or

(c) One coat of synthetic primer in accordance with TT-P-1757, modified to a dark green color (approximating color no. 34128 (dark green) in accordance with FED-STD-595). The dry film thickness shall be approximately 1.5 to 2.0 mils and shall be not less than 1.5 mils at any one point.

30.5 The drying time of the coating specified in 30.4 at 73°F shall be as follows:

Specification	Type	Drying time (max)
DOD-P-15328	Formula 117	30 minutes
MIL-P-15930	Formula 120	30 minutes
TT-P-645	Formula 84D	6 hours
TT-P-1757	Formula 84D	30 minutes

Higher temperatures may be used to shorten the drying time.

30.6 The coatings specified in 30.4 shall be selected for the desired length of protection. Protection for approximately 9 months should be provided by cleaning, followed by:

(a) one coat of alkyd primer, in accordance with TT-P-645, or one coat of primer coating, in accordance with TT-P-664.
(b) one coat of alkyd zinc-chromate primer, in accordance with TT-P-645 (formula 84/47).
(c) one coat of synthetic paint, in accordance with TT-P-1757.

APPENDIX C

CERTIFICATION TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that should be included on certification when required by the contract or order. This appendix is mandatory only when the appropriate data item description is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. CERTIFICATION DATA

30.1 Certification data contents. When required by the contract or order, certification data shall contain the following information:

(a) Plates, shapes, and bars shall have a certified mill report (signed by a responsible representative of the contractor), and inspection data identifiable by plate, shape, and bar numbers and heat numbers which shall include the following:

(1) Copy of certified mill report and inspection setting forth results of examination and tests. A copy of certification documents shall be sent in accordance with section 43 of the ABS Rules and an additional copy each to the contracting agency, or as otherwise specified.

(2) Statement that "Each lot has been sampled, tested and inspected in accordance with the specification and meets all specification requirements. Records are available covering heat number of the material used, processing of plate, shape, and bar, dimensional control employed, ultrasonic testing, heat treatment, chemistry and mechanical properties."

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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:PARTMENT OF THE NAVY
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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-S-22698C (SH)	Steel Plate, Shapes and Bars, Weldable Ordinary Strength

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
	☐ USER
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426

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(TO DETACH THIS FORM, CUT ALONG THIS LINE.)